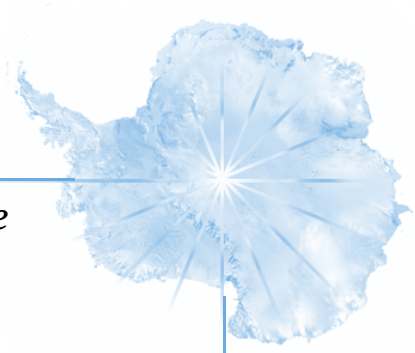
ANTARCTICA

the farthest place close to home



Why is Antarctica the Windiest Place on Earth?

OVERVIEW

Students investigate the factors that contribute to extremely windy conditions in Antarctica. They examine reports from Antarctic weather stations to understand the wind patterns there. A hands-on experiment illustrates how cold air reacts with warmer air; and thus how the behavior of cold air could contribute to the formation of katabatic winds in Antarctica.

CONCEPT

Katabatic Winds, Causes of Extreme Winds, Topographic Features, Cold and Warm Air.

OBJECTIVES

- Develop hypotheses to explain extreme winds in Antarctica.
- Research causal factors for high winds.
- Analyze data; determine patterns.
- Draw reasonable conclusions.

CURRICULUM UNIT

Produced by the American Museum of Natural History in collaboration with Rice University.

Cover image courtesy of the U.S. Geological Society.

contents at a glance

TEACHER STRATEGIES

This **timeline** offers a day-by-day plan for using all the components in the unit, including suggestions for supplementary readings, discussion questions, homework assignments, and readings for further study. **Assessment strategies** include portfolio assessment and day-to-day accountability for students working both individually and in small groups.

ACTIVITIES*

Prepare Your Investigation: Wind Patterns
Students use first hand information, including quotes and data sets plus their prior knowledge of wind and the behavior of cold and warm air to frame their investigation of Antarctica's extremely windy conditions.

Research on the Web: Antarctic Weather Stations
Students examine weather data from Antarctic weather stations to understand the varying wind patterns across the continent.

Classroom Activity: Crazy Cold Air
Hands-on experiment in which students investigate the behavior of cold air by measuring temperatures of cold air rushing out of a walk-in freezer or refrigerator.

READINGS*

INTERVIEWS WITH ANTARCTIC RESEARCHERS

Let's Talk with Carole Bennett about Studying Snow and Wind in Antarctica
Carole Bennett, a high school chemistry teacher who participated in a research expedition, discusses her experience in Antarctica, her path into teaching, and her love of knowledge.

Let's Talk with Gerd Wendler about Studying Polar Climate
Gerd Wendler, a professor of polar climatology, discusses his work studying Antarctica's katabatic winds.

CONTENT READING

Letter from Stephanie: Katabatic Winds
Stephanie Shipp, a scientist conducting research in Antarctica, shares her work and discoveries in letters home. This letter discusses the factors that contribute to the formation of Antarctica's katabatic winds.

ANTARCTICA IN THE NEWS

Two current articles relating to wind, especially the katabatic winds of Antarctica. You'll find suggestions for these articles in **Additional Resources** at the end of the Teacher Strategies section.

* Download activity and readings from the Museum's Antarctica Special Collection, located at: http://www.amnh.org/education/resources/antarctica. Prepare Your Investigation is enclosed.

teacher strategies | NATIONAL STANDARDS

NATIONAL SCIENCE & SOCIAL STUDIES STANDARDS	 PREPARE YOUR INVESTIGATION Wind Patterns	 RESEARCH ON THE WEB Antarctic Weather Stations	 CLASSROOM ACTIVITY Crazy Cold Air
LIFE SCIENCES			
Structure and function in living systems			
Reproduction and heredity			
Regulation and behavior			
Populations and ecosystems			
Diversity and adaptation of organisms			
PHYSICAL SCIENCES			
Properties and changes of properties in matter	✓	✓	✓
Motions and forces	✓	✓	✓
Transfer of energy	✓	✓	✓
EARTH AND SPACE SCIENCE			
Structure of the Earth system			
Earth's history			
Earth in the solar system			
UNIFYING CONCEPTS/PROCESSES			
Systems, order, organization	✓	✓	✓
Evidence, models, explanation	✓	✓	✓
Change, constancy, and measurement	✓	✓	✓
Evolution/equilibrium			
Form and function			
SCIENCE AS INQUIRY Students should be able to:			
Identify questions/hypotheses	✓	✓	✓
Design investigations	✓	✓	✓
Think critically/create relationships	✓	✓	✓
Draw reasonable conclusions	✓	✓	✓
GEOGRAPHY Students should understand these concepts:			
The characteristics, functions, and applications of maps, globes, aerial and other photographs, satellite-produced images and models.			
The relationships between people and environments and the connections between people and places.			

teacher strategies | TIMELINE

BEFORE DAY 1

Answer "Questions to Explore" from Prepare Your Investigation: Wind Patterns

READINGS

A secondary source article relating to the extreme winds in Antarctica, e.g.:

"Katabatic Winds: Antarctica: A Land of Ice and Wind"

	DAY 1	DAY 2	DAY 3	DAY 4
IN THE CLASSROOM	 **PREPARE YOUR INVESTIGATION** Wind Patterns	 **RESEARCH ON THE WEB** Antarctic Weather Stations	 **CLASSROOM ACTIVITY** Crazy Cold Air	 **PORTFOLIO** Students begin portfolio compilation and final projects using the handout Putting It All Together
HOMEWORK	 **INTERVIEW WITH RESEARCHER** Let's Talk with Gerd Wendler about Studying Polar Climate	 **INTERVIEW WITH RESEARCHER** Let's Talk with Carole Bennett about Studying Snow and Wind in Antarctica	 **LETTER FROM STEPHANIE** Katabatic Winds	 **PUTTING IT ALL TOGETHER**

* Download activity and readings from the Museum's Antarctica Special Collection, located at: http://www.amnh.org/education/resources/antarctica. Prepare Your Investigation is enclosed.

FINAL ASSESSMENT

Celebration of Student Work

Students present projects and create displays of their work.

Any kind of celebration will offer immeasurable validation of student work!

Optional:

CLASSROOM ACTIVITY

Antarctic Extreme Jeopardy

INTRODUCTION

This is a timeline for the unit **Why Is Antarctica the Windiest Place on Earth?** It is designed for classes with 45- to 55-minute periods. This timeline uses all components in the unit; or you can pick and choose to customize your unit. Suggestions are made here for using the readings; you can also give out the readings at the beginning of the unit, along with the portfolio sheet, and tell students that they are responsible for completing the readings on their own time by the portfolio due date. Most daily plans assume that collected group work sheets and other assignments will be returned the following day, or, in the case of group work, on the next day that groups meet.

The unit, and each individual activity within it, is designed to encourage the development of habits of mind. Students not only learn about the winds of Antarctica; they also develop their skills required for scientific inquiry, examining what they know already in framing an investigation, developing new questions, and engaging in research and activities to explore these questions. Readings supplement Internet research and hands-on experiments. Students record their observations and findings in research journals before preparing a final project. This final project corresponds to the publication stage of scientific research. You can find suggestions for structuring this final project on the handout **Putting It All Together**.

CREATE AN EXHIBIT

If you plan to work with more than one unit from the Antarctica curriculum, **Create an Exhibit** is an excellent final project. Students design and create a real exhibit, or simply design an exhibit on paper by preparing models of the physical space, a script for a visitor's progress through it, text that could be used in displays, and explanations of interactive displays or videos. This second option allows students to work outside the limits of space and funding, making full use of their skills and understanding without having to worry about what they can actually create. Divide the class into groups, with each one responsible for a specific big idea, e.g., "day and night cycles of Antarctica." You can also divide the class according to their roles—curators, designers, writers, etc.

The creation of an exhibit is one of the final project ideas at the end of each unit. This is a wonderful final project option for individual students, even if you are only exploring one unit in the curriculum.

If you plan to create an exhibit or simply design one on paper, you will need to plan for it from the very first day. Broach the topic with your students on Day 1 and ask them to keep lists of items or concepts they would like to include. Return to these lists throughout the course of the unit. A running class list on newsprint, hung in your classroom, can provide a foundation for your final planning stages after you have completed your study of Antarctica.

BEFORE DAY 1

READINGS

During this unit, students record thoughts, ideas, questions and observations in their own journals, as well as responses to their reading. Whether or not your students are already using a science journal, create one for this unit. Your students can purchase them, or create them by stapling about twenty-five blank pages inside a cardstock cover. The homework assignment for Day 1 asks students to design a journal cover with images and/or words; this provides a creative way for them to get involved in the unit. As students learn more about Antarctica's extreme winds, ask them to add to the images and/or words on their covers. In the final assessment, include a question about how their journal covers changed over the course of the unit. If this is your first time using journals, discuss their function with your students—how to keep them, what to write, what not to write, what not to worry about (grammar, spelling, being "right"), and what to explore (thinking deeply and critically, close observation, description, questioning).

Before you begin the unit, ask students to answer "Questions to Explore" from the first section of **Prepare Your Investigation: Wind Patterns**. This is an excellent homework assignment for the night before or as an in-class activity. Ask students to read "**Katabatic Winds: Antarctica: A Land of Ice and Wind**" and write a response in their journals.

DAY 1

PREPARE YOUR INVESTIGATION

Each unit in the curriculum **Antarctica: The Farthest Place Close to Home** includes cooperative learning activities, some of which may be adjusted for individual work at home or in class. Keep in mind that many students do not yet know how to work effectively in groups. Spend some time discussing effective cooperative learning before you ask students to work cooperatively.

If you are using only one unit in the curriculum, begin the first day with a writing task that asks students to think about effective group work, e.g.:

- When you are working with other students, what makes you want to participate? What makes you feel reluctant to participate?
- How do you help your teammates take part in discussion? What might you do that could make it difficult for others to participate?

Ask a few students to share their written responses to generate a discussion of effective cooperative learning practices before starting the group activity.

If you are using more than one unit in the curriculum, you will not need to repeat this discussion with each new unit, though some or all of your students may need refresher discussions as you proceed. Substitute the following writing task to help your students prepare for the activity to come:

- What did you learn about wind from last night's reading?
- What predictions can you make about Antarctica's winds?
- What new questions do you have about wind across the globe and in Antarctica—or about Antarctica in general?

Students then complete the second portion of **Prepare Your Investigation: Wind Patterns**. As you circulate, either collect homework (journals) or simply mark that students have completed the assignment and reserve a more detailed check for a journal collection date.

After groups complete the activity, gather together as a class. Create a class list of hypotheses and ideas for testing those hypotheses. Then return to this list after the unit to compare the final findings to the early hypotheses.

INTERVIEW WITH RESEARCHER

HOMEWORK: Read **Let's Talk with Gerd Wendler about Studying Polar Climate** and write a response. Using today's investigation as a starting point, students create a cover for their Why is Antarctica the Windiest Place on Earth? journals. Images and/or words should convey their vision of Antarctica's wind patterns. Encourage them to be creative and thoughtful, and to think of this as the first step in an ongoing process. They will add to their covers as their study of Antarctica's extreme winds progresses.

DAY 2

RESEARCH ON THE WEB

If all of your students have access to the Web, use **Research on the Web: Antarctic Weather Stations**, in which students examine wind patterns at ten Antarctic weather stations, as an out-of-class assignment, with or without groups/partners. If not, use class time for students to use the interactive Web site. As you circulate, either collect homework (responses) or simply mark that students have completed the assignment and reserve a more detailed check for the portfolio collection date. Check beforehand to make sure that the site is up and running.

Note: Each classroom should have the National Geographic Map of Antarctica. This map shows elevation in both visual and numerical form.

To help students interpret the data, use some of the questions below to guide them. Remember to guide them to interpret, rather than interpreting for them!

- Look at the wind speeds in areas like Wilkes Land and the Ross Sea area. Consider Terra Nova Bay, Ross Ice Shelf, and Cape Denison. Why might the winds be so strong in these regions? What is different about them? (These are regions with mountains.)
- What happens when winds funnel from an open area to a narrow area? (The winds get stronger.)

- What happens when the wind flows down from the interior of Antarctica and funnels through the mountains? (The winds get much stronger.)

Regroup as a class after the Web investigation to discuss the day's findings and to generate a class list of findings.

INTERVIEW WITH RESEARCHER

HOMEWORK: Complete the write-up of **Research on the Web: Temperatures Across the Globe**. Read **Let's Talk with Carole Bennett about Studying Snow and Wind in Antarctica** and write a response.

DAY 3

CLASSROOM ACTIVITY

Now that students have spent some time familiarizing themselves with extreme winds, take stock of their original questions and their developing understanding. Start the class with a writing task that helps them to think about this process:

- Consider your original questions about extreme winds. What questions have you been able to answer so far? What new questions have arisen?
- What experiments might help you answer your questions?
- What facts will you need to help you answer your questions?

After students write for a few minutes, ask them to share their responses as a way to generate discussion before moving on to the next activity. Ask them to continue to think about their questions, and to be open to developing new questions, as they conduct their **Classroom Activity: Crazy Cold Air**. Ask students to answer the focus questions from the activity as a homework assignment, or as a writing task during the beginning of the next class. Those questions are:

- If a gas is heated, it expands, becomes lighter and rises. If it is cooled, it becomes denser and sinks. How does this rule apply to the air that rushes out when you open a freezer door?
- How can this phenomenon help to explain wind direction patterns in Antarctica?

As they conduct the experiment, circulate and ask the students to explain the differences in temperature for thermometers at different heights. This will help you assess their understanding.

If you feel your students' graphing skills are shaky, offer a model before letting them move into groups. Try something simple, such as asking for a show of hands of all winter birthdays, all spring, summer and fall. Create a quick graph on the board in which you illustrate how to determine intervals, how to label axes, how to draw the graph using the intervals and points, etc. Students should understand that in order to compare their data, they need to use the same type of graphs for each set of data. Ask them to decide which type of graph is most useful for answering their questions.

Regroup as a class after the activity to discuss the day's finding and to generate a class list of findings. As groups complete the same activity, focus your discussion on process and the different findings and techniques, rather than having the same information presented by all groups.

LETTER FROM STEPHANIE

HOMEWORK: Read **Letter from Stephanie: Katabatic Winds** and write a response.

DAY 4

PORTFOLIO

Ideally, use a full class day to help students begin portfolio compilation and final projects. If not, you can use today's handout as a homework assignment.

Begin class with a short writing task:

► Describe the factors that contribute to Antarctica's extreme winds.

PUTTING IT ALL TOGETHER

Ask a few students to share their responses. Use these responses as a segue into a discussion of the portfolio. The self-assessment will ask them to think further about what they learned during the unit. They will also complete a final project and they can begin thinking about that today. Distribute and discuss the handout **Putting It All Together**. Give students time to read through the handout and complete their responses. Then gather as a class to discuss your deadlines and expectations for projects and portfolios.

During the rest of the class period, students can begin compiling portfolios and putting together ideas for their final projects. Circulate to troubleshoot for individual students and discuss ideas with groups or with the class. At the end of the period, ask a few students to share some of their questions or project ideas so that everyone can get on the right track.

A note about project choices: The handout **Putting It All Together** includes ideas for a final project to be included in the portfolio; you may want to add some of your own ideas to this list.

Each unit in the Antarctica curriculum includes similar project ideas adapted for the unit. If you are using only one unit in the Antarctica curriculum, offer students a choice among the project ideas. If you are using more than one unit, ask students to choose one project and use it for each unit—for example, one student might have a series of penpal letters while another has a series of children's books. Or, ask students to choose a different project each time. Be sure that students understand your expectations before they begin to work on their projects.

FINAL ASSESSMENT: Celebration of Student Work

If your final day is a Friday and students have been keeping up, have your portfolios due on Monday. Make sure you have given out the portfolio sheet at the beginning of the unit so that students are clear on expectations well in advance.

This final due date is cause for celebration—celebrate your students' achievements by asking them to present their projects; then create displays of their work. Invite other classes or members of the school community to the presentations. Any kind of celebration will offer immeasurable validation of student work!

On the day that portfolios are due, reserve time at the beginning of class for a discussion of the unit. Use the questions below to structure your discussion. Out of this discussion, the class can develop a chart, or a more formal visual presentation, of their findings. Then use this chart as a centerpiece for a display of student work.

- What questions did you investigate, individually, and in groups?
- What conclusions did you develop?
- What methods did you use to find your answers?
- How does your information fit into the bigger picture?
- How does it contribute to answering the question of why winds are so extreme in Antarctica?
- What new questions do you have? How might you research the answers?

Have students assess each other's portfolios. Ask them to use the same assessment sheet or provide other criteria for their assessment.

CLASSROOM ACTIVITY

If you plan to have a test as part of your final project, or if you want students to review the unit's content, you can adapt **Classroom Activity: Antarctic Extreme Jeopardy** in the unit **What Hazards Do Humans Encounter in Antarctica?** as a review. Simply change the categories to suit the content of the unit.

PUTTING IT ALL TOGETHER

Congratulations! You have completed your research on **Why is Antarctica the Windiest Place on Earth?** Take a few minutes to think about what you learned during this unit. What is important about the knowledge and skills you acquired during your study? What did you learn that you think other people should know?

1. As part of your portfolio, prepare a creative final project. Your project will draw on all of your newly acquired knowledge and skills; it may also draw on some of your new questions. Consider your response above as you examine the list of project ideas.

- Create a narrative or a dramatization that explains why Antarctica has such powerful winds. You might choose to have a narrator and a cast of characters, or simply to have a scene between two or three, such as Antarctic landforms that help to funnel the winds to the coast and the coastal areas that are battered by them. (A narrative might follow the style of Homer's *Ulysses*, or another text you are reading in your Language Arts class.) Use what you have learned about all the factors contributing to the extreme winds, especially katabatic winds, to create the narrative or the dialogue. For example, your scene may begin with the "birth" of a katabatic wind.
- Imagine that you are the curator of a museum exhibit about winds in Antarctica. Design an exhibit that will teach the public about extreme winds. Consider the big ideas, or themes, of your exhibit: What does your audience need to know about extreme winds and why? How can you illuminate those big ideas using the senses of sight and sound and even touch? Who will see your exhibit? What do they know already? What ideas will be totally new for them? What resources will you need to create the exhibit? What will it look like? Consider every stage, from entrance to exit. Your plan should include a map, explanatory text for displays/interactives/video, and a script that shows the way a viewer will progress through the exhibit.
- Write a children's book explaining why Antarctica has such powerful winds.
- You are a reporter for the local/school/Antarctica newspaper. Write an article explaining why Antarctica has such powerful winds. This could also be done as a script for a TV news broadcast or documentary. Include explanations of the visuals that would be used.
- Write a letter to a student in another class (or a pen pal, sibling, parent, etc.) explaining why Antarctica has such powerful winds.
- Design a Web site that explores why Antarctica has such powerful winds. This assignment could be completed as an individual, group, or class Web site. Explain the images and layout you would use, and include the accompanying text.

PUTTING IT ALL TOGETHER

2. Of the project ideas listed above, which project sounds most interesting to you? Why? What ideas do you have for completing this project?

3. What questions do you have about completing this project?

4. Your teacher will have specific due dates and expectations for your project and final portfolio. Record them in the space below.

PORTFOLIO

As you complete your study of extreme winds in Antarctica, you will develop a body of work that includes your Antarctica journal, your reading responses, group work (one copy per group), and any other written or visual records of your investigation. Your **final portfolio** includes your scientific research, showing your process, and your final project pieces that are ready for sharing and/or publication. During this process, you are working just as scientific researchers work. Keep in mind that all your work will be part of your evidence for your final presentations.

Readings represent an important part of your research. After completing each reading, write a complete response of about a page; this will help you to develop your understanding of the reading. Use the questions below to help you create an in-depth response to the reading. Think of your response as a mini-essay on the reading, rather than just a list of answers to questions. Mark the readings you need to complete by placing a check next to the required titles below.

A **final project** will help you organize everything you learned. Think of your final project as the scientific paper you publish based on all of your research. In your final project, explain what you learned about Antarctica, and offer evidence from your image research, Web research, and readings. Your teacher may ask you to follow a specific format for your final project.

In your **self-assessment**, think about your learning process—what you did, how your group worked together, how you worked alone. Think about both the unit and your own performance. Questions to use for the assessment are found below.

Your **Why is Antarctica the Windiest Place on Earth?** Portfolio is due on _____.

Place a check next to each reading selection you are being asked to read.

___ Let's Talk with Carole Bennett about Studying Snow and Wind in Antarctica
___ Let's Talk with Gerd Wendler about Studying Polar Climate
___ Letter from Stephanie: Katabatic Winds

___ _____
___ _____
___ _____
___ _____

Questions to Use for Reading Responses

1. What is the reading selection about?
2. How is the selection relevant to your study of wind patterns in Antarctica?
3. What did you learn from the selection?
4. What questions do you have after reading the selection?
5. What did you like about the selection? What did you dislike about it?

Questions to Use for Your Final Project

1. Discuss what you learned from this unit. Why does Antarctica experience such strong winds? Why do some areas in Antarctica experience stronger winds than others?
2. How is this knowledge important to your knowledge of science? Of other fields of study?
3. What questions do you have for further study?

Questions to Use for Your Self-Assessment

1. Discuss your work in this unit as a team member.
2. Discuss your individual work in this unit.
3. What suggestions do you have for the next time this unit is taught? Consider suggestions both for the teacher and for future students.

PORTFOLIO GRADE SHEET

Congratulations on completing your study of extreme winds in Antarctica. Your grade for this project is broken down below.

ANTARCTIC JOURNAL	SCORE
▸ How well did you explain your ideas?	
▸ How well did you use illustrations to clarify ideas or demonstrate processes?	
▸ How well did you keep up with journal entries?	
GROUP WORK	**SCORE**
Everyone in your group will receive the same score for this section. You can't get credit if you weren't present for the group work (unless you can work out alternate arrangements). ▸ Prepare Your Investigation: Wind Patterns	
▸ Research on the Web: Antarctic Weather Stations	
▸ Classroom Activity: Crazy Cold Air	
READING RESPONSES	**SCORE**
Your score reflects how well you developed your response to each reading selection. ___ Let's Talk with Carole Bennett about Studying Snow and Wind in Antarctica	
___ Let's Talk with Gerd Wendler about Studying Polar Climate	
___ Letter from Stephanie: Katabatic Winds	
___	
___	
___	
FINAL PROJECT	**SCORE**
Your project score reflects how thoroughly you understood the concepts of the unit, and how well you presented your understanding of these concepts in your project. You can find further explanation of your score on the **Project Rubric** page.	
SELF-ASSESSMENT	**SCORE**
Your score reflects how deeply you examined your process in the unit, both working as an individual and as part of a team.	
COMMENTS	**TOTAL SCORE**

PROJECT RUBRIC

Congratulations on completing your final project for Why is Antarctica the Windiest Place on Earth? Your score for this project is broken down below.

COMPONENT	SCORE
How well did you understand the key concepts of this unit? ► Did you clearly outline each concept? ► Did you offer examples to explain and illustrate each concept? ► Did you make connections between the key concepts? ► Were you able to apply the key concepts to real-world scenarios, showing that you understand the extreme wind patterns of Antarctica?	
Were you able to think critically about Antarctic winds? ► Were you able to develop hypotheses and explain how you came up with them? ► Were you able to look at the evidence from your research and experiments and draw conclusions using that evidence? ► Were you able to apply your conclusions to your original hypotheses, figuring out how you did or did not prove them? ► Were you able to develop alternate hypotheses based on your research and experiments?	
How well did you present your ideas, both in terms of the project you prepared and how you presented it to the class? ► Did you use illustrations and other supplementary material to help your readers understand what you wrote? ► Is your project clear and easy to follow? ► Were you able to explain your project to the class clearly? Did you speak so that everyone could hear you? Did you make eye contact with your audience, speaking without just reading your notes? Did you seem confident with your presentation and your understanding of the unit? ► Were you able to participate in the discussion and answer the questions generated by your presentation?	

teacher strategies

ADDITIONAL RESOURCES

READINGS

Use the article listed below for homework readings. You can also substitute articles that you or your students find. The article below appears in the timeline; but if you are unable to find it, look for current articles that relate to Antarctica generally, or specifically about Antarctica's extreme winds.

- "**Katabatic Winds: Antarctica: A Land of Ice and Wind.**" *Weatherwise*, May/June 2001, v. 53, i. 1: p. 14-24.

WEB SITES

Listed below are some of Stephanie Shipp's favorite Web sites for information on wind, especially the katabatic winds of Antarctica.

- **Description of Douglas Mawson's expedition around Cape Denison "Home of the Blizzard."**
  http://www.70south.com/resources/history/chapter17
  http://www.south-pole.com/99.htm

- **Image of waves at sea**
  http://www.glacier.rice.edu/Images/oceans/4_jb-awaves.jpg

- **Image of tents and people in a blizzard**
  http://www.glacier.rice.edu/Images/weather/-3_ervtentstormdave.jpeg

- **Image of Antarctic wind patterns**
  http://www.glacier.rice.edu/Images/weather/3_airflow.gif

- **A dramatic image of katabatic winds in action**
  http://www-bprc.mps.ohio-state.edu/imagery/bromcolor6.gif
  http://www-bprc.mps.ohio-state.edu/imagery/antarctic.html

- **Automatic Weather Station**
  http://uwamrc.ssec.wisc.edu/aws/AntAWS.gif

- **Real time weather patterns**
  http://uwamrc.ssec.wisc.edu/aws/AntAWS.gif

PREPARE YOUR INVESTIGATION
Wind Patterns

VOICES FROM ANTARCTIC RESEARCHERS

"A few years ago we put into the field in early October (still springtime in Antarctica). On the second day, the wind started blowing, the tents shaking—it was a katabatic wind storm. The wind must have been blowing over 100 mph! Large pieces of gravel were blowing in the air, pounding the tent. We couldn't work; we couldn't even hear each other talk, because the wind roared like a train coming down the valley. Little twisters carrying gravel blasted the tent. The wind blew away the outdoor toilet we'd weighted down with large rocks. Every now and then we made forays out to add more rocks to the tent flaps and to shovel sand on the flaps. I was afraid the tents would blow away.

It was so windy inside the tents, even with the door closed, that the fire kept blowing out; and all of our food and water was frozen solid. We slept with juice packs in our sleeping bags to melt them so we wouldn't dehydrate. We could barely reach McMurdo on the radio because our antenna blew down. This lasted for three full days; I don't think either of us will ever forget it."

— ***Brenda Hall*** *is a glacial geologist who studies rock formations in the McMurdo Dry Valleys. She often needs to camp in remote areas to conduct her research.*

"Antarctica is well known for its ferocious winds. Because of the force of gravity, dense, cold air flows from the high polar plateau in the middle of the continent down toward the coast, just like a stream or creek. Landforms channel the airflow, forcing winds to converge and become even stronger. Wind speeds can increase from quiet conditions to 15 to 20 m/sec (50 to 66 ft/sec) instantaneously! Once these intense winds reach the coast, they're called katabatic winds."

— ***Gerd Wendler*** *is Professor of Polar Meteorology at the Geophysical Institute of Alaska. His team established Cape Denison as the windiest place on Earth after installing rugged instruments that could withstand the so-called katabatic winds.*

PREPARE YOUR INVESTIGATION | **Wind Patterns**

WEATHER CLASSIFICATIONS ISSUED BY MCMURDO STATION'S WEATHER OFFICE	
Condition III	Winds up to 48 knots, wind chill down to –75°F, and visibility over 1/4th mile. Unrestricted travel and activity are allowed, but severe weather is possible within 12 hours.
Condition II	Winds 48 to 55 knots, wind chill –75° to –100°F, or visibility 100 feet to 1/4th mile. Restricted pedestrian traffic only between buildings in allowed. Travel is allowed only on marked trails or roads in authorized, radio-equipped vehicles.
Condition I	Winds over 55 knots, wind chill lower than –100°F, or visibility less than 100 feet. Severe weather is in progress. All personnel must remain in buildings or the nearest shelter.

The weather office at McMurdo Station uses these criteria to determine restrictions on activities for people working in and around the base.

QUESTIONS TO EXPLORE

- How does cold air move?
- What are the wind patterns in Antarctica?
- What factors interact to make Antarctica's winds so powerful?

BEFORE YOUR INVESTIGATION

Before scientists begin an investigation, they look at what they know in order to figure out what they need to know. A testable idea explaining a scientific phenomenon is called a **hypothesis**; you can come up with any idea you want to explain something, as long as you can test it!

Scientists start with what they know in order to develop the questions and make the observations that allow them to create a hypothesis. From there, they develop a way to test that hypothesis. After a lot of research, they usually have to scrap the original hypothesis and develop a new one! Follow the first part of this process in your investigation today by defining what you know and what you want to find out.

PREPARE YOUR INVESTIGATION | Wind Patterns

Before you begin researching the windy conditions of Antarctica, consider what you already know about wind. How much you already know isn't important—focus on organizing your thoughts and thinking deeply about what you know and what you want to investigate. Look at "Voices from Antarctic Researchers" to begin to develop some hypotheses. Then think about ways to test your hypotheses. Use your **journal** to record your responses.

WHAT DO YOU ALREADY KNOW ABOUT WIND?

- What are the windiest conditions you ever experienced? Where were you at the time?
- How does warm air behave differently from cold air? Think about the temperature in an attic compared to the temperature in a basement in the summertime. Or consider why people use ceiling fans during the winter.
- What other questions do you have about wind patterns at the poles, or where you live or across the globe?

EXAMINE SOME PRELIMINARY DATA.

- Look at the weather condition categories in "Voices from Antarctic Researchers." Explain the differences in the categories in terms of conditions and restrictions.
- Look at the quotes from research scientists in "Voices from Antarctic Researchers." Discuss your reaction to these two scientists' observations about and experience of conditions in Antarctica.

DEVELOP YOUR HYPOTHESES.

- Why do you think Antarctica is such a windy place? How might you test your hypotheses?

PREPARE YOUR INVESTIGATION | Wind Patterns

After you have organized your ideas in your journal, gather with your teammates. Pick a captain and a note taker for the day. With your group, discuss the day's findings.

In your discussion, consider how your observations of wind and the movement of air are similar and different. Consider how your interpretations of the data in "Voices from Antarctic Researchers" are similar and different—and then compare your hypotheses. With your group, determine which hypotheses you want to test, and determine possible ways to test those hypotheses.

The captain makes sure everyone participates in the discussion, while the note taker takes notes on what you learned and what you want to know, as well as on how group members contributed to the discussion. Use the worksheet or your own paper, as your teacher requests.

In Antarctica, winds are considered fairly calm at 48 knots, or 55 mph. Compare that to a windy March day in New England, when average winds reach 11 knots or 13 mph.

PREPARE YOUR INVESTIGATION | **Wind Patterns**

GROUP WORKSHEET
ANTARCTIC TEAM __

GROUP MEMBERS _____

CAPTAIN _____ **NOTE TAKER** _____

1. What ideas did you share about windy conditions and the behavior of warm and cold air? What ideas were different?

2. What were the group's final interpretations of the data in "Voices from Antarctic Researchers"?

3. What hypotheses did the group discuss?

HYPOTHESIS	HOW WE COULD TEST OR RESEARCH THE HYPOTHESIS?

GROUP DYNAMICS

Comment on how each group member participated in today's discussion.